Structural Fabrication Quality Assurance Guidance Document

Description

The purpose of this document is to provide the Michigan Department of Transportation's (MDOT) Structural Fabrication Unit guidance to supplement MDOT's Materials Quality Assurance Procedures (MQAP) Manual. This guidance document will be used to ensure statewide consistency in performing quality assurance (QA) verification inspection at fabrication facilities. The Structural Fabrication Unit is responsible for implementing the Department's quality assurance program for structural elements required to be accepted based on "Fabrication Inspection" per MDOT's MQAP Manual and utilizes vendors to provide the shop inspection. It is imperative for the quality assurance inspector (QAI) to completely understand their role and responsibilities when performing QA verification inspection on MDOT projects to ensure a successful QA program. It is important to note that this document is not contractual and all project related decisions should be based on the project specifications. This document is broken down into the following sections:

1. Definitions
2. Contact Information
3. Responsibilities
4. QAI Roles and Responsibilities
5. QAI Frequent Questions and Answers

1. Definitions

Below is a list of terms that are significant to this guidance document:

1.1 Contractor

The Contractor is responsible for proper completion of all tasks required by the contract. Subcontractors, including fabricators, erectors, and field painters, may be used by the Contractor, but the Contractor retains responsibility for all material, operations, and the final product. The Contractor should permit direct subcontractor interaction with MDOT to expedite the project, but subcontractors must inform the Contractor of any proposed modifications to contract requirements.

1.2 Design Project Manager (PM)

The Design PM can be the Engineer of Record or could be managing a consultant contract where the consultant is the Engineer of Record.

1.3 Engineer

The Engineer can be the Director of the Department of Transportation or the MDOT Construction Engineer designated by the Director, acting directly or through authorized representatives, who is responsible for engineering supervision of the construction. The Engineer has the authority to allow exceptions to contract document requirements.

1.4 Engineer of Record (EOR)

Those preparing the contract documents, including those responsible for the structure's adequate design. The Engineer of Record seals and signs the contract plans.

1.5 Fabricator

The facility performing such shop activities as cutting, welding, drilling, punching, tying rebar, tensioning strand, pouring concrete, cleaning and painting of structural steel, etc. The Fabricator also includes any agents of the Fabricator, such as those who prepare shop detail drawings, perform non-destructive examinations, paint, etc. In some cases the Fabricator may also be the Contractor, but the Fabricator is typically a subcontractor.

1.6 Fabrication Inspection

The examination by MDOT or the Fabricator of processes and products to verify general conformance with contract requirements.

1.7 Fabrication Inspection Acceptance

The first step in MDOT's two part acceptance process for structural elements required to be accepted based on "Fabrication Inspection" per MDOT's MQAP Manual.

1.8 Field Inspection Acceptance

The second step in MDOT's two part acceptance process for structural elements required to be accepted based on "Fabrication Inspection" per MDOT's MQAP Manual.

1.9 Materials Quality Assurance Procedures Manual (MQAP)

The formal written document prepared by MDOT that describes the policies and procedures used to accept materials for incorporation into MDOT projects. The document contains inspection procedures for fabricated structural precast (prestressed and non-prestressed) concrete, structural steel, and other structural elements.

1.10 Michigan Department of Transportation (MDOT)

The entity (owner) paying the Contractor to fulfill the terms of the contract. MDOT also encompasses the Engineer who is authorized and responsible for engineering supervision of the construction. The Engineer is an employee of MDOT; however, MDOT may contract with a professional firm to oversee the day to day supervision with all critical decisions coming through the Engineer.

1.11 Nonconformance Report (NCR)

An alteration in the work or a fabrication error that results in the element not meeting project specifications. The fabricator generates a NCR submittal after fabrication has begun and their quality control inspector (QCI) has noted a nonconformance to the project specifications.
Nonconformances are generally defined to be material or workmanship in nature and are further classified by MDOT to be minor or major. Minor nonconformances can be repaired by the fabricator without approval of a NCR, whereas major nonconformances require approval of a NCR.

1.12 Precast Concrete

Precast concrete is a construction product produced by casting concrete in a reusable form, which is then cured in a somewhat controlled environment, transported to the construction site, and lifted into

place. Precast concrete can be either prestressed or non-prestressed. In contrast, cast-in-place (CIP) concrete is poured into site-specific forms and cured on site.

1.13 Procedure Qualification Record (PQR)

A production welding procedure specification (WPS) qualification is based on a procedure qualification test record (PQR) produced by the Contractor in conformance with required heat input qualifications and other code requirements. The test is designed to provide assurance that the weld metal produced by welding in conformance with the provisions of the code must produce weld metal strength, ductility, and toughness conforming to the code.

1.14 Quality Assurance (QA)

Quality assurance (QA) encompasses the activities undertaken by the Owner to verify that the final product satisfies contract requirements, including verifying that quality control is performed effectively.

1.15 Quality Assurance Inspector (QAI)

MDOT's representative that is responsible for duties specified in the MDOT MQAP, with the authority to accept work that meets contract requirements.

1.16 Quality Control (QC)

The activities undertaken by the Contractor/Fabricator to ensure a product is provided that meets contract requirements.

1.17 Quality Control Inspector (QCI)

A qualified employee of the Fabricator who performs inspection as defined by the Fabricator's Quality Control Plan.

1.18 Quality Control Plan (QCP)

The formal written document prepared by the Fabricator and reviewed by a certification agency (AISC, NPCA, PCI, etc.) that describes the policies and procedures used to verify that fabricated structural precast (prestressed and non-prestressed) concrete, structural steel, and other structural elements will satisfy the contract requirements.

1.19 Request for Information (RFI)

Requests by the Fabricator seeking additional information or proposing alternate material, fabrication method, or inspection method for the structural element.

1.20 Spot Inspection

The random examination of the Fabricator's processes or products for verification of conformance with contract requirements.

1.21 Structural Fabrication Unit

MDOT's specialized QA unit that is responsible for implementing the Department's QA program for all structural elements required to be accepted based on "Fabrication Inspection" per MDOT's MQAP.

1.22 Welding Procedure Specification (WPS)

Is a formal written document describing welding procedures, which provides direction to the welder or welding operators for making sound and quality production welds as per the code requirements.

The purpose of the document is to guide welders to the accepted procedures so that repeatable and trusted welding techniques are used.

2. Contact Information

The Structural Fabrication Unit can be contacted by phone or email. QAI's are required to bring urgent matters to the appropriate contact person by phone and then immediately follow up by email for record and attach all applicable supporting documentation to the email. All other matters are required to be submitted via email and then a call, if needed, can be setup. The Structural Fabrication Unit's email resource is shown below:

MDOT-StructuralFabrication@michigan.gov

3. Responsibilities

3.1 Team Effort

3.1.1 The Contractor, Fabricator, and MDOT will approach quality control and quality assurance as a team effort to facilitate accurate and timely construction.

3.1.2 All parties will cooperate and maintain open lines of communication so that problems can be quickly addressed and resolved.

3.1.3 The QAI's verification does not relieve the Fabricator from the responsibility to perform the required testing and inspection and produce a product satisfying the contract.

3.2 Fabricator

3.2.1 Provide quality control to ensure that the finished product meets or exceeds contract requirements.

3.2.2 Develop and implement a QCP that reflects a commitment to quality and describes the quality control activities that will be employed on each project.

3.2.3 Provide MDOT with a copy of the QCP.

3.2.4 Submit shop drawings to MDOT for review with weld procedure specification (WPS) and supporting procedure qualification record (PQR), as applicable.

3.2.5 Provide structural precast concrete Material Source List (MSL) prior to the prefabrication meeting.

3.2.6 Provide qualified QCIs who report to personnel responsible for quality control as defined by the QCP.

3.2.7 Provide MDOT with an accurate notification before beginning work in the shop and all production scheduling as required by the contract requirements.

3.2.8 Present all material for the QAI's acceptance in a manner that will allow a thorough inspection of components and assemblies.

3.2.9 Provide the QAI full access to shop facilities where the work is being stored, fabricated, or assembled.

3.2.10 Provide the QAI with all approved shop drawings, NCRs, RFIs, MDOT Welder Qualification test reports, WPSs, QC reports, material certifications/test reports, NDE reports, personnel/plant certifications, equipment calibration reports, and all other applicable documents in a timely manner as required by the contract requirements.

3.2.11 Keep the QAI informed prior to performing in-process repairs, NCRs (if applicable), QC inspection activities, and pending nondestructive examination (if applicable).

3.3 MDOT

3.3.1 Monitor the Fabricator's control of the operations and verify conformity of the work with the contract requirements.

3.3.2 Keep the Fabricator's QCP confidential.

3.3.3 Observe fabrication (either on a schedule or at random) and perform testing of materials and fabricated elements as necessary to confirm the effectiveness of the Fabricator's QCP.

3.3.4 MDOT has the right to observe all phases of the work, from initial receipt and preparation of raw materials through prestressing, tying steel, fresh concrete testing, placing concrete, testing cylinders, repairs, burning and cutting, welding, nondestructive testing, cleaning, coating, shipping, and any other activities deemed appropriate by MDOT.

3.3.5 The frequency and nature of QA inspection will vary with the type of structure, experience of the Fabricator, strength of the Fabricator's QC organization, and other similar factors that affect the quality of work.

3.3.6 Verify that production quality and fabrication processes generally satisfy contract requirements, including the QCP.

3.3.7 Accept materials and fabricated elements that satisfy the contract requirements.

3.3.8 Notify MDOT when fabricator ships elements for projects, and specify if the shipment is the final shipment for the project.

3.3.9 Submit project file to MDOT within one week of final shipment of elements.

3.3.10 MDOT will not waive items that are contractual obligations of the Fabricator and will not accept material that does not conform to the contract requirements. However, based on experience and knowledge of the specific situation, the Engineer may accept materials and elements that are not in conformance with the contract and may allow material substitutions. See the following two documents for more information:

- *MDOT Structural Fabrication RFI Process*
- *MDOT Structural Fabrication Nonconformance Policy*

3.3.11 MDOT will not direct the Fabricator's work. However, MDOT should advise the Fabricator to discontinue any operation that would result in noncompliance with the contract.

3.3.12 MDOT will direct all official communications to the Fabricator's quality control or management as determined in the prefabrication meeting.

3.3.13 MDOT will not convey directives or personal judgements about overall shop quality or concerns about employee competence to production personnel.

3.3.14 MDOT will not publish, copy, or distribute any proprietary information, documents, or forms received from the Fabricator for any purpose other than the contractual needs of MDOT.

3.4 Prefabrication Meetings

Prefabrication meetings facilitate effective quality control and quality assurance and are conducted by MDOT's Structural Fabrication Unit prior to the start of fabrication and preferably after shop drawings have been approved. The Structural Fabrication Unit, QAI, Fabricator, and QCI must be present, whereas the Engineer and Contractor should be present to ensure a team effort to facilitate accurate and timely construction. Quality assurance and quality control contact information will be shared during this meeting to ensure effective and timely communication.

4. QAI Roles and Responsibilities

4.1 Qualifications of the QAI

Qualification requirements of the QAI is covered in the MDOT MQAP Manual for the type of inspection required.

4.2 Equipment Requirements of the QAI

Equipment requirements of the QAI is covered in the MDOT MQAP Manual for the type of inspection required.

4.3 Scheduling

The scheduling of inspection and other QA functions can have a significant impact on the project. The QAI must follow these guidelines:

4.3.1 Coordinate with the QCI for anticipated production scheduling to anticipate timing and staffing needs. Discuss the progress of the work with appropriate fabrication personnel designated during the prefabrication meeting.

4.3.2 Schedule inspections in a timely manner to facilitate fabrication progress, especially if multiple shifts are used.

4.3.3 Discuss with the Structural Fabrication Unit whether additional presence in the shop is required.

4.3.4 Document problems with scheduling inspection, including inaccurate information from fabrication personnel and production delays.

4.4 Role of the QAI

4.4.1 Perform verification tests, measurements, inspection, or observations to ensure that fabricated elements conform to the contract requirements. Although the QAI does not perform the QC work, some QA activities may duplicate a portion of the QC activity for verification purposes.

4.4.2 If there are questions about a requirement or level of quality, contact the Structural Fabrication Unit and, if appropriate, alert the Fabricator.

4.4.3 Conduct consistent inspections based on the contract requirements and obtain assistance from the Structural Fabrication Unit as needed.

4.4.4 Be familiar with the QCP to better understand the QC operations of the shop.

4.5 Responsibilities of the QAI

See subsection 3.3 above for a list of QAI responsibilities.

4.6 Interaction with the Fabricator QCI

4.6.1 Verify the effectiveness of the QCI's evaluation of the work.

4.6.2 Perform verification inspection after the QCI has completed their inspection and testing in accordance with the Fabricator's QCP. However, serious problems noted at any time or stage of fabrication must be immediately pointed out to the QCI.

4.6.3 Though QA inspection may include all aspects of fabrication, **the QAI must not supersede QC**, which is the responsibility of the Fabricator. If QC is not accomplishing its role then the Structural Fabrication Unit, Engineer, Contractor, and Fabricator must determine the necessary corrections.

4.7 Interaction with Fabricator

If the Fabricator's inquiries involve design questions, material substitutions, alternate fabrication methods, or items that are beyond the authority of the QAI, refer them to *MDOT's Structural Fabrication Request for Information Process*. If the Fabricator's inquiries involve fabrication or material nonconformance questions, refer them to *MDOT's Structural Fabrication Nonconformance Reporting Process*. Do not direct the fabricator.

4.8 Interpretation of the Contract

Review contract requirements and seek guidance from the Structural Fabrication Unit if the QAI has questions. Do not direct the Fabricator.

4.9 Fabrication Observation

4.9.1 Establish a pattern of regular and frequent observations during the progress of work to verify satisfactory workmanship without delaying production or missing critical operations.

4.9.2 Coordinate verifications with the QCI and accomplish them with minimal additional material handling by the Fabricator and with as little interference with the work in process as possible.

4.9.3 Though there are not designated points during fabrication when the suitability of materials must be checked, problems should be discovered and addressed as early as possible.

4.9.4 Provide narrative record keeping in accordance with applicable sections of the MQAP manual.

4.10 Nonconforming Materials and Workmanship

See *MDOT's Structural Fabrication Nonconformance Policy* and *MDOT's Structural Fabrication Nonconformance Reporting Process* for more information.

4.11 Final Acceptance of the Work

Acceptance of structural elements must be in accordance with *MDOT's MQAP Manual*.

5. QAI Frequent Questions and Answers

The purpose of this section is to provide answers to frequently asked questions to ensure consistency and alignment.

5.1 Fabricating without Approved Shop Drawings

The QAI must notify the Structural Fabrication Unit immediately if the Fabricator is working without MDOT approved shop drawings. Approved shop drawings are required prior to stamping elements approved for shipping.

5.2 Inspecting Approved Repair Plans

QAI must have the approved repair plan in hand prior to performing QA verification inspection of the repair. Verification inspection also includes confirming that production and QCI have the approved repair plan. If production and QCI do not have the approved plan then the QAI must notify them that they are required to have the approved plan in hand during all aspects of the repair. If the Fabricator begins working on the repair without the approved plan then the QAI must notify the Fabricator of their observation in writing immediately and carbon copy the Structural Fabrication. The Structural Fabrication Unit will notify the Engineer and Fabricator that the repair is recommend to be rejected.

5.3 Stamping Elements Approved for Use

QAI must have approved shop drawings prior to stamping any element approved for use. Elements proposed to be shipped by the Fabricator that are not in general conformance with the approved shop drawings must not be stamped. The only exception is if a nonconformance report (NCR) has been approved by MDOT. Approved NCRs are to be used in conjunction with approved shop drawings for acceptance. If elements are not in conformance with the approved shop drawings then they are not to be stamped approved for use by the QAI. If requests for information (RFI) have been approved by MDOT for the project then they must be incorporated into the shop drawings, if applicable, prior to shipping.

5.4 Welder Qualification Testing

See *MDOT's Welder Qualification Program* for all welding information.

5.5 As-Built Shop Drawings

The Fabricator is required to submit as-built shop drawings to MDOT for historical purposes. All approved RFIs that are incorporated into the project must be added to the shop drawings and submitted to MDOT for review and approval. Very minor changes toward the end of fabrication must be documented and submitted as as-built shop drawings to the QAI prior to shipping. The Structural Fabrication Unit can provide more guidance on a project by project basis as to what constitutes a shop drawing revision and what is considered an as-built.